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Laboratory Tests With Candidate Toxicants Against the Gypsy Moth

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by

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INTRODUCTION

During the past several years there has been a continuing search for safe and effective spray materials to control the gypsy moth, *Porthetria dispar* (Linnaeus). As early as 1891 investigators were experimenting with Paris green, London purple, arsenate of lead and arsenate of soda.[2] However, until DDT was introduced most spray materials tested were found to be either inefficient or phytotoxic. As is true today, materials that looked good in the laboratory, were not always effective under field conditions.

The advent of DDT revolutionized the insecticide industry and led some investigators to predict the eventual eradication of a number of undersirable insects and insect-carrying diseases. During the late forties and fifties, DDT was used on large acreage for gypsy moth control. Although excellent results were obtained, erradication of the insect from extensive areas was not achieved. Furthermore, a number of investigators felt that DDT applications seriously limited populations of parasites and predators that were established in this country during the twenties and thirties.

Although parasite numbers were lowered, along with the gypsy moth, the majority survived the DDT treatments.[3]

During the late fifties much public opposition developed over the use of the chlorinated hydrocarbons and DDT was soon on the way out. As the use of DDT was phased out in many States the carbamate, carbaryl, became the insecticide most widely recognized for gypsy moth control. Carbaryl is a short-lived insecticide, compared to DDT; the material is broken down a few days after application. However, as people have become increasingly more concerned with environmental pollution, even carbaryl has come under periodic attack by environmentalists. Therefore, an active screening program was needed to test the increasing number of compounds, in the hope of finding an effective, safe material that will be accepted by all.

This publication presents a number of candidate insecticides that have been tested in the laboratory for toxicity to the gypsy moth larvae using both a diet and a seedling test method. A number of insecticides have also been tested in the field on experimental test plots.

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[2] Forbush, E. H. and C. H. Fernald. 1896. "The gypsy moth." Wright and Potter Printing Co., State Printers, Boston, Mass.

[3] Dowden, P. B. 1961. The persistence of gypsy moth parasites in heavily sprayed areas on Cape Cod, Mass. J. Econ. Entomol. 54 (5).

PROCEDURES

Diet Test

Artificial diet similar to that described by Leonard and Doane[4] was melted in a large glass beaker until approximately 200 ml of readily flowable diet was available. This was poured into eight 50 ml beakers, 24 ml per beaker. Insecticide was then introduced into individual dishes at the appropriate amount to get dosages wanted in parts per million (ppm).

After mixing well, the content of each beaker was spread evenly over the bottom of three plastic petri dishes (15 MMX 100 mm), giving each dose three replicates. The content of one beaker, containing diet only, was spread over three petri dishes for a check.

When diet became firm, 10 second instar gypsy moth larvae were introduced into each petri dish. Test dishes were then held in an environmental chamber at 80° F. with a relative humidity of 60 percent. Mortality was recorded each 24 hours for 3 days and in some cases 4 days. When there was no longer any visual signs of larval movement, mortality was assumed.

[4]Leonard, D. E. and C. C. Doane. 1966. An artifical diet for the gypsy moth, *Porthetria dispar*. Annals of the Entomological Society of America. Vol. 59, No. 3: pp. 462-464.

Seedling Test

Tender Northern red oak seedlings, germinated in a greenhouse, were sprayed individually in a laboratory spray tower described by Merriam (1967).[5] Plants were treated in replicates of five with most tests being accompanied by a standard consisting of DDT, carbaryl-trichlorfon. Five untreated plants accompanied each test as a check.

Once treated, 10 activitely feeding second instar larvae were introduced onto each seedling, including checks.

Following treatment and introduction of the larvae, all seedlings were held in an environmental chamber with temperature maintained at 80° F. (27° C.), and a relative humidity of 65 percent. Mortality readings were made at 24-hour intervals after insect introduction.

The criterion for death was no reaction when larvae were prodded gently with a dissecting needle.

Second instar larvae were used because they normally correspond to the target stage in field control operations.

[5]Merriam, W. A. 1967. Test with a laboratory low-volume spray device. J. Econ. Entomol. 60 (1); pp 274-276.

RESULTS

The toxicants tested and results of seedling tests are listed in table 1. Table 2 presents the diet test results. A total of 71 formulations were tested using the seedling test method and 20 using the diet method.

Table 1.–Seedling tests

[Note: All rates were 1 gal. per acre unless otherwise stated]

Material	Dosage (lb. ai./ac.)	Percent mortality			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
Accothion 500	.50	54	74	94	100
	.25	54	64	89	100
Acephate	1.00	90	100		
	.50	82	100		
	.25	72	100		
	.125	58	100		
Aminocarb	.25	42	86	98	
Azinphosmethyl	.75	84	96	96	100
	.50	86	96	98	100
	.25	68	87	92	97
AC-72841	2.00	0	0	0	
	1.00	0	2		
AC-84484	1.00	0	0	0	
	1.50	4	10	16	
Carbaryl 80S	1.00	85	98	100	
	.50	88	100		
	.25	43	78	98	
Carbaryl-4-011	1.00[1]	85	98	100	
	1.00[2]	54	73	98	
	.75[2]	56	90	94	
Cartap	1.00	16	80		
	.50	50	50		
Chlordime Form	1.00	0	4		
	.75	0	18	86	
	.50	6	8	84	
	.25	4	4	84	
DDT	.75	54	98	100	
	.50	44	98	100	
Diazinon	1.00	100			
	.50	38	52		
Dimethrin	3.30	52	92	98	
Dipel (BT)	1.00[3]	12	64	96	98
	1.00[4]	2	24	62	86
	1.00[5]	6	58	76	92
Ethyl Parathion Encap	.25	48	88		
Fenthion	.25	16	42	70	84

See footnotes at end of table.

Table 1.–Seedling tests–Continued

[Note: All rates were 1 gal. per acre unless otherwise stated]

Material	Dosage (lb. ai./ac.)	Percent mortality			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
Gardona 75 percent W/P	1.00	88	100		
	.25	49	86	98	
Gardona WDL-4	1.00	64	92	94	
Herc 16801	1.00	6	33	38	
	.75	4	48	74	
Imidan IE	.50	64	98	98	100
	.25	44	84	100	
Imidan 50 W/P	1.00	48	72	96	
	.50	24	62	76	
Leptophos	1.00	83	100		
	.50	81	96	98	
	.25	77	95	100	
	.125	66	91	100	
	.0625	47	87	98	
	.0312	24	76	100	
Malathion Encap	1.00	7	27	29	
MC-4044	1.00	20	30		
Meswrol	1.00	58	80	96	
	.50	26	70	90	
Metalkamate	1.00	72	86	98	
Methamidophos	.25	86	--	100	
Methomyl-L	1.00	100			
	.50	92	100		
	.25	88	100		
Methomyl-W/P	.25	78	100		
Methyl-Trithion W/P	.75	74	96	100	
Methyl-Trithion L/E	.75	54	86	96	
Mobam	1.00	96	100		
	.50	91	100		
	.25	66	92	98	
Mon-856	1.00	74	99	100	
	.75	47	90	100	
	.50	46	94	99	
	.25	16	62	78	
Ortho 269	1.00	100			

See footnotes at end of table.

Table 1.–Seedling tests–Continued

[Note: All rates were 1 gal. per acre unless otherwise stated]

Material	Dosage (lb. ai./ac.)	Percent mortality			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
Ortho XE-272	1.00	100			
	.50	94	100		
Ortho 13362	1.00	49	81	92	
	.50	58	90	98	
Ortho 14040	1.00	96	98	100	
Ortho 15223	1.00	88	96		
	.50	82	96	100	
Perma Guard D10	10.00	0	1	33	
	5.00	2	6	11	
Perma Guard D21	10.00	100			
	5.00	25	30	41	
Propoxur	1.00	50	74	89	
Pyrocide 175	1.00	67	85		
	.125	12	26	38	
Resmethrin	.25	2	62	100	
	.125	0	44	90	
	.063	0	32	74	
	.0315	0	4	26	
Resmethrin	.25	69	100		
EC	.125	66	94	98	
	.063	54	88	96	
Resmethrin	.25	73	99	100	
ECLXA	.125	68	93	99	
	.063	30	68	82	
Resmethrin	.25[6]	29	39	65	
ENCAP	.125	13	21	31	46
	.063	0	10	12	42
Resmethrin ECXY	.25	74	100		
Resmethrin Con #40	.25	70	100		
Resmethrin EN1	1.00[7]	23	67	86	
Resmethrin ECLX	.25	86	98	100	
R-15022	.125	52	72	86	
	.25	44	60	88	
R-15792	.125	54	74	88	

See footnotes at end of table.

Table 1.–Seedling tests–Continued

[Note: All rates were 1 gal. per acre unless otherwise stated]

Material	Dosage (lb. ai./ac.)	Percent mortality			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
R-15996	1.00	88	100		
	.50	30	48	90	
R-23680	1.00	66	66	66	66
RH-1170	1.00	32	54	87	
	.75	29	52	81	
	.50	27	36	80	
	.25	19		66	
SD-7438	1.00	52	68	84	
SD-8530	1.25	50	86	100	
	.125	34	96	100	
SD-9098	.50	78	98		
	.125	76	98	100	
Sevimol #4	1.00	58	84	99	
	.50	44	76	88	
TET Romethrin	.20	88	92	94	
Torak	1.00	100			
	.50	50	71		
	.25	4	28	52	
Trichlorfon	1.00	76	97	100	
	.50	60	93	98	
	.25	31	73	99	
U-22024	.25	38	50	60	
U-24157	.25	8	16	16	20
XRD 36A	.167	20	34		
Zectran	.167	88	100		
	.125	62	91	100	
Zolone EC	1.00	68	90		
Zolone W/P	1.00	36	67	100	

[1] Undiluted.
[2] Diluted 25 percent with kerosene.
[3] Dipel + molasses - 1 application.
[4] Dipel + Glycol - 1 application.
[5] Dipel + oil - 1 application.
[6] .5 gal/ac.
[7] 2 gal./ac.

Table 2.–Diet tests

Material	Dosage	Percent mortality			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
Accothion 500	1000	29	60	85	100
	750	12	26	49	
	500	6	12	22	
	250	0	1	1	
Acephate	1000	70	97	100	
	750	23	57	87	97
	500	57	83	100	
	250	7	67	83	87
	125	0	3	43	73
	62	0	0	0	3
Aminocarb	1000	97	97	100	
	750	93	100		
	500	88	100		
	250	57	97	100	
	125	33	77	100	
	63	3	7	20	37
Azinphosmethyl	1000	47	87	93	
	750	40	93	97	
	500	27	80	90	
	250	27	80	97	
	125	17	70	73	
	63	33	83	90	
Chlordime Form	1000	10	30	40	
	750	22	37	47	
	500	15	44	67	
	250	15	39	52	
	125	8	34	44	
	63	7	29	43	
	31	4	5	20	
DDT	1000	0	32	100	
	750	0	27	69	
	500	0	5	42	
	250	0	7	18	
Fenthion	1000	3	13	23	
	750	3	7	10	
	500	0	7	10	
	250	0	0	0	
Gardona 75 W/P	1000	21	62	77	
	750	23	68	91	
	500	25	61	68	
	250	10	26	58	
	125	3	7	15	
Leptophos	1000	50	97	100	
	750	40	50	87	
	500	43	57	80	
	250	37	57	77	
	125	27	67	93	
	63	20	27	37	

Table 2.–Diet tests–Continued

Material	Dosage	Percent mortality			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
Mesurol	1000	57	88	90	
	750	43	77	90	
	250	7	7	10	
Mon-856	1000	37	65	92	97
	750	28	60	87	97
	500	16	59	75	87
	333	0	30	57	87
	250	3	20	30	55
	200	0	7	--	40
Baygon	1000	73	97	100	
	750	50	97	97	
	500	47	77	87	
	250	26	62	78	
	100	7	23	43	
R-15792	1000	60	100		
	750	50	97	100	
	500	35	97	100	
	250	25	87	92	
	125	8	59	69	
Trichlorfon	1000	53	97	100	
	500	33	80	100	
	250	27	60	100	
Zectran	1000	97	100		
	750	91	99	100	
	500	85	100		
	250	67	85	100	
	125	53	87	98	
	63	27	45	65	

APPENDIX

[Codes: Bt–Bacillus thuringiensis, P–Phosphate, C–Carbamate, O–Ovicide, N–Nereistoxin, PY–Pyrethrin, CH–Chlorinated Hydrocarbon]

Compound	Chemical name	Company	Ent no.	Compound class	Oral LD 50 Male rats (mg/kg)
Accothion 500	O, 0-dimethyl 0-4-nitro-m-tolyl phosphorothioate	Cyanamid	25715	P	503.5
Acephate[1]	O, S-Dimethyl acetyl-phosphoramidothioate	Chevron	27822	P	945
Aminocarb	4-Dimethylamine-m-tolyl methylcarbamate	Chemagro	25784	C	50
Azinphosmethyl	O, 0-Dimethyl S-[4-oxo-1, 2, 3,-benzotriazin-3 (4H)-ylmethyl] phosphorodithioate	---do---	23233	P	80
AC 72841	Confidential	Cyanamid	70394	O	1,210
AC 84484	Confidential	---do---	70395	O	850
Carbaryl 80S[1]	1-Naphthyl N-methylcarbamate	Union Carbide	23969	C	400
Cartap	S, S-[2-(Dimethylamino) trimethylene] bis (thiocarbamate)	Chevron	27573	N	250
Chlordimeform	N-(4-Chloro-o-tolyl)-N, N-dimethyl-formamidine	Nor-Am	27567	O	350
Chlorpyrifos[1]	O, 0-Diethyl 0-(3, 5, 6-trichloro-2-pyridyl) phosphorothioate	Dow	27311	P	155
DDT[1]	1, 1, 1-trichloro-2, 2-bis (p-chlorophenyl) ethane	City Chem.	1506	CH	113
Diazinon	O, 0-Diethyl 0-(2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate	Geigy	19507	P	466 ± 87
Dimethrin	2, 4-Dimethylbenzyl-2, 2-dimethyl-3-(2-methyl-propenyl) cyclopropenecarboxylate	MGK	21170	PY	40G/KG
Dipel[1]	Bacillus thuringiensis W/P viable spore Preparation of Berliner (MD-strain)	Abbott	-----	BT	---
Dowco 214	O, 0-dimethyl 0-(3, 5, 6-T richloro-2-pyridyl) phosphorothioate	Dow	27520	P	941
DPX 1764	S-methyl-1-carbamoyl-N-[(methylcarbamoyl) oxy] thioformimidate	DuPont	27817X	C	26
Ethyl Parathion (Encap)	O, 0-Diethyl-0-pnitro phenyl phosphorothioate	Pennwalt	15108	P	5
Fenthion	O, 0-Dimethyl 0-4-methylthio)-m-tolyl phosphorothioate	Chemagro	25540	C	313
Gardona[1]	2-Chloro-1-(2, 4, 5-trichlorophenyl) vinyl dimethylphosphate	Shell	25841	P	4,000
Herc 16801	Phenyl N-dimethoxy-phosphinodithioacetyl N-methylcarbamate	Hercules	27954	C	400
Imidan[1]	N-(Mercaptomethyl) phthalimide S-(O, 0-dimethylphosphorodithioate)	Stauffer	25705	P	216
Leptophos[1]	0-(4 Bromo-2, 5-dichlorophenyl) 0-methyl-phenylphosphonothioate	Velsicol	27378	P	90.5
Malathion (Encap)	O, 0-dimethyl phosphorodithioate of diethylmercaptosuccinate	Cyanamid	17034	P	1,375
MC-4044	Confidential	Mobil	27744	P	310
Mesurol	4(methylthio)-3, 5-xylyl methylcarbamate	Chemagro	25726	C	130

See footnote at end of table.

[Codes: Bt–Bacillus thuringiensis, P–Phosphate, C–Carbamate, O–Ovicide, N–Nereistoxin, PY–Pyrethrin, CH–Chlorinated Hydrocarbon]

Compound	Chemical name	Company	Ent no.	Compound class	Oral LD 50 Male rats (mg/kg)
Metalkamate	m-(Ethylpropyl) phenyl methylcarbamate and m-(l-methylbutyl)-phenyl methylcarbamate in approx. ratio of 1:3	Chevron	27127	C	170
Methamidophos	O, S-Dimethy phosphoramicothioate	---do---	27396	P	29.9
Methomyl	S-Methyl N-[(methylcarbamoyl) oxy] thioacetimidate	DuPont	27341	C	17
Methyl-Trithion	O, 0-dimethyl S(((p-Chlorophenyl)thio) methyl) phosphorodithioate	Stauffer	25599	P	200
Mobam	4-Benzothinyl N-methyl carbamate	Rohm & Haas	27041	C	234
Mon-856	Confidential	Monsanto	27824	-	44
Ortho 269	---do---	Chevron	27649	C	66
Ortho XE-272	---do---	---do---	-----	P	98
Ortho 13362	---do---	---do---	-----	C	500
Ortho 14040	---do---	---do---	-----	C	104
Ortho 15223	---do---	---do---	-----	P	180
Perma-Guard D10 D21	Diatomaceous Earth	Perma Guard Corp.	-----	-	---
Propoxur	0-Isopropoxy phenyl methylcarbamate	Chemagro	25671	C	128
Pyrocide 175	20% ± 0.6 W/W Pyrethrins by AOAC method	MGK	-----	PY	820
Resmethrin[1]	5-Benzyl-3-furyl methyl-2, 2-dimethyl-3-(2-methylpropenyl) cyclopropane carboxylate	S.B. Penick	27474	PY	2,500
R-15022	Confidential	Stauffer	27549	P	7
R-15792	---do---	---do---	27632	P	58
R-15996	---do---	---do---	27647	P	79
R-23680	Phenyl-Propynl Ether	Stauffer	27947	-	3,160
RH-1170	Confidential	Rohm & Hass	-----	P	150
SD-7438	Toluene-alpha, alpha dithiol bis (O, O, dimethyl, phosphorodithioate	Shell	25739	P	280
SD-8530	3, 4, 5-trimethylphenyl) methylcarbamate	---do---	25843	C	178
SD-9098	Q-[2-chlore-1-(2, 5-dichlorophenyl) vinyl] O,0-diethyl phosphorothioate	---do---	27102	P	102
Sevimol #4	1-Naphthyl N-methylcarbamate + molasses	Union Carbide	23969	C	400
Tetromethrin	1-Cyclohexene-1, 2-dicarboximidomethyl 2, 2-dimethyl-3-(2-methylpropenyl) = cyclopropanecarboxylate	Sumitome	27339-D	PY	5,200
Torak	S-(2, Chloro-1-phthal-imidoethyl) O, 0-diethyl phosphorodithioate	Hercules	27322	P	5-71
Trichlorfon[1]	Dimethyl (2, 2, 2-trichloro-1-hydroxyethyl) phosphonate	Chemagro	19763	P	450
U-22024	Confidential	UpJohn	27352	-	-
U-24157	---do---	---do---	27264	-	-
XRD-36A	Wax Emulsion	Mobile	23969	C	850

See footnote at end of table.

APPENDIX–(Continued)

[Codes: Bt–Bacillus thuringiensis, P–Phosphate, C–Carbamate, O–Ovicide, N–Nereistoxin, PY–Pyrethrin, CH–Chlorinated Hydrocarbon]

Compound	Chemical name	Company	Ent no.	Compound class	Oral LD 50 Male rats (mg/kg)
Zectran[1]	4-Dimethylamine-3, 5-xylyl N-methylcarbamate	Dow	25766	C	15-62
Zolone	O, 0-Diethyl S-(6-chloro benzoxazolone-3-yl-methyl) phosphorodithioate	Rhodia	27163	P	100-180

[1] Materials that have been tested in the field.

Mention of a proprietory product in this publication does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture nor imply its approval by the Department to the exclusion of other products that may be suitable also.